Salmonid Population Status and Trends

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Knowledge Assessment

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Phoenix, AZ

Strategic Science Questions Relevant to This Discussion

1.3	Do RBT migrate from Glen Canyon? If so, at what life stages? To what extent do outmigrants support populations downstream of Lees Ferry?
1.4	Can RBT be reduced by mechanical removal?
1.8	How can native and non-native fish best be monitored?
3.2	To what extent could predation impacts by nonnative fish be mitigated by dam-controlled high-flow releases?
3.6	What GCD operations maximize trout fish opportunities and catchability?
5.6	Do potential benefits associated with improved native fish rearing habitat (i.e., more stable flows) outweigh negative impacts due to increases in nonnative fish?

Overview

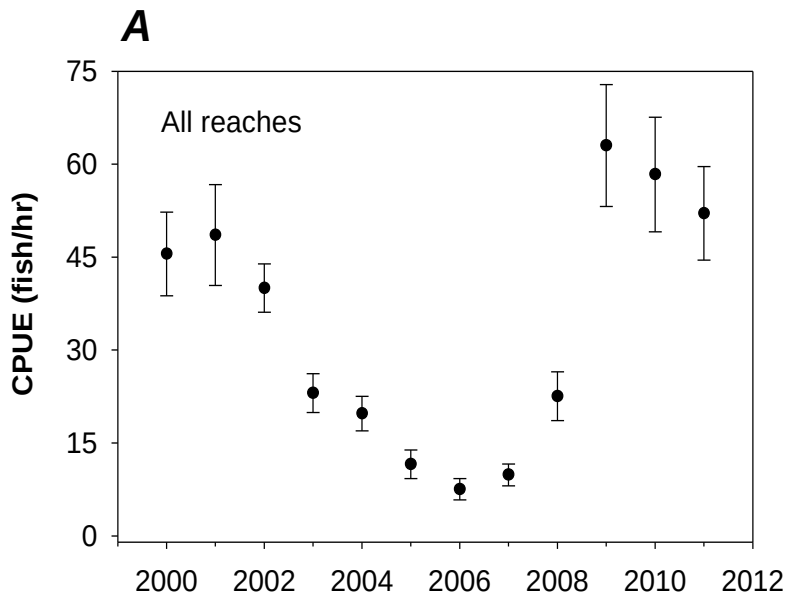
- Trends in catch per effort (CPE) of rainbow trout and brown trout in Marble Canyon and LCR inflow reach.

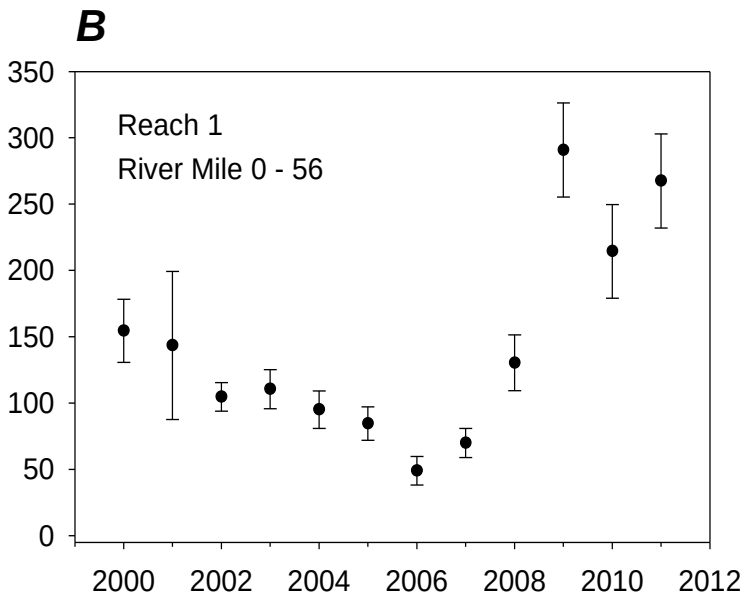
- What drives trends in abundance?
  - Effects of flow from Glen Canyon Dam on recruitment in the Lees Ferry reach
  - Movement of rainbow trout from Lees Ferry to Marble Canyon
  - Relationship between Lees Ferry recruitment and immigration to Marble Canyon

- Key Management Uncertainties
  - Bias and imprecision in CPE as an index of abundance in case of Marble Canyon rainbow trout
  - Efficacy of suppression flows and mechanical removal
  - Efficacy of Bright Angel weir

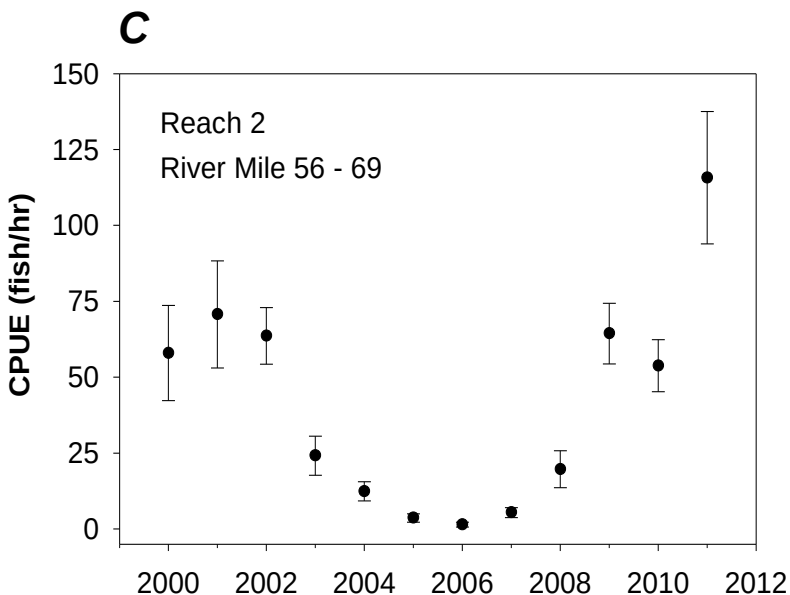
Trends in Rainbow and Brown Trout Abundance

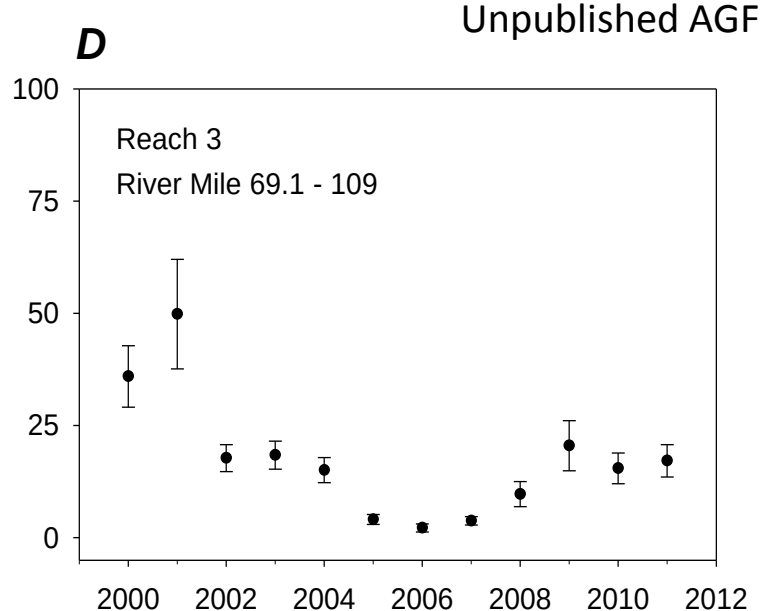
Trends in Rainbow Trout Catch Per Effort





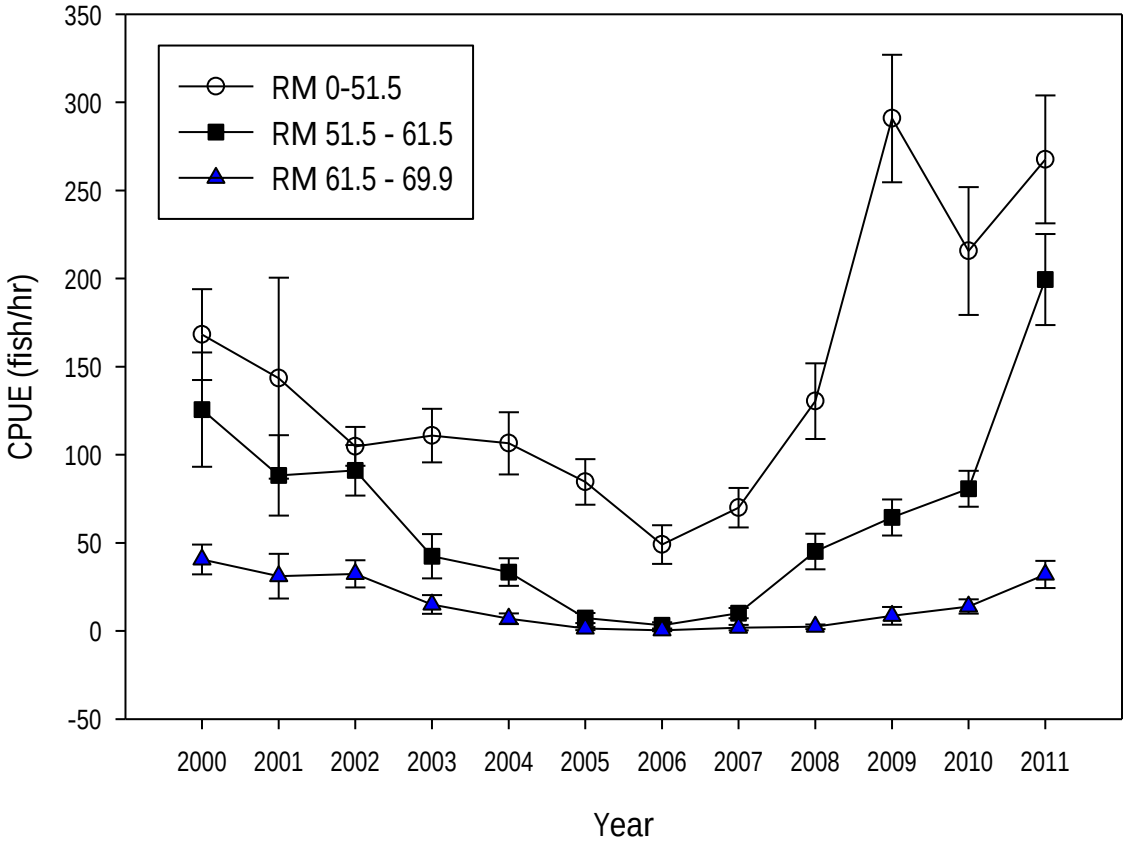
Unpublished AGFD data





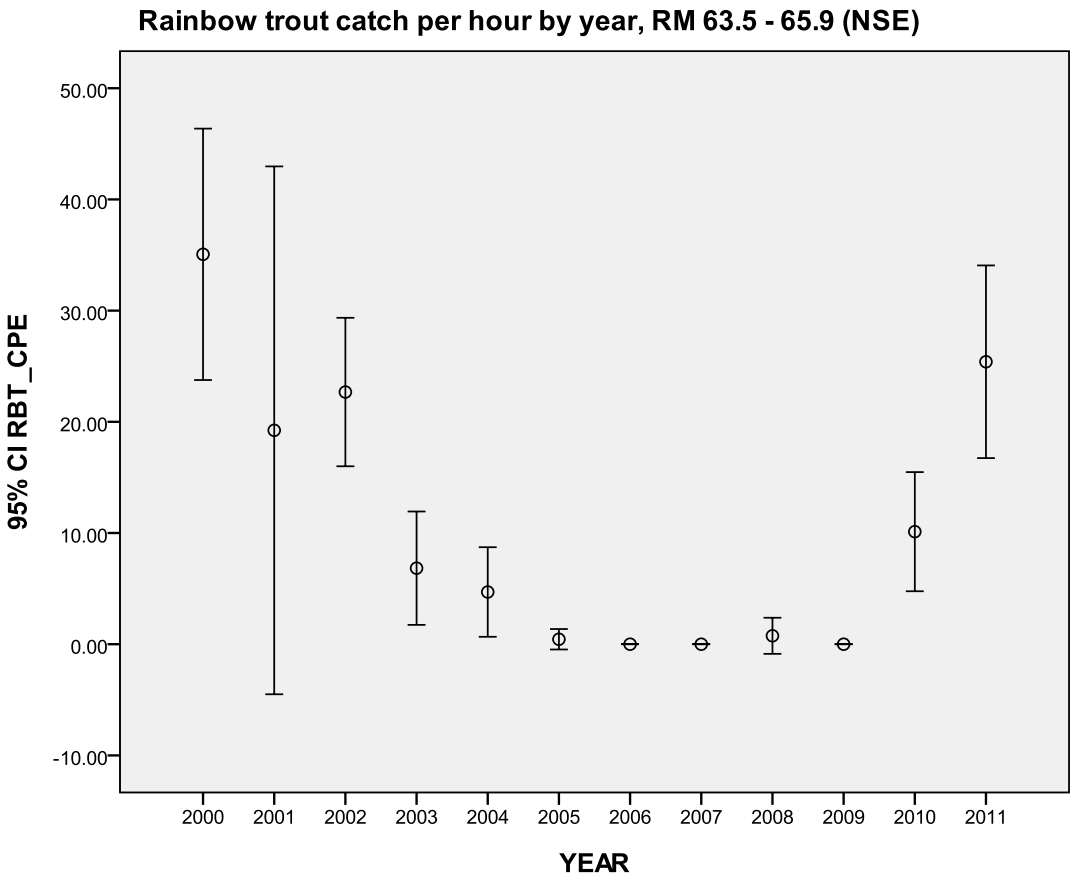
Trends in RBT CPE in Marble Canyon and LCR Inflow Reach

Rainbow trout CPUE, standardized monitoring.

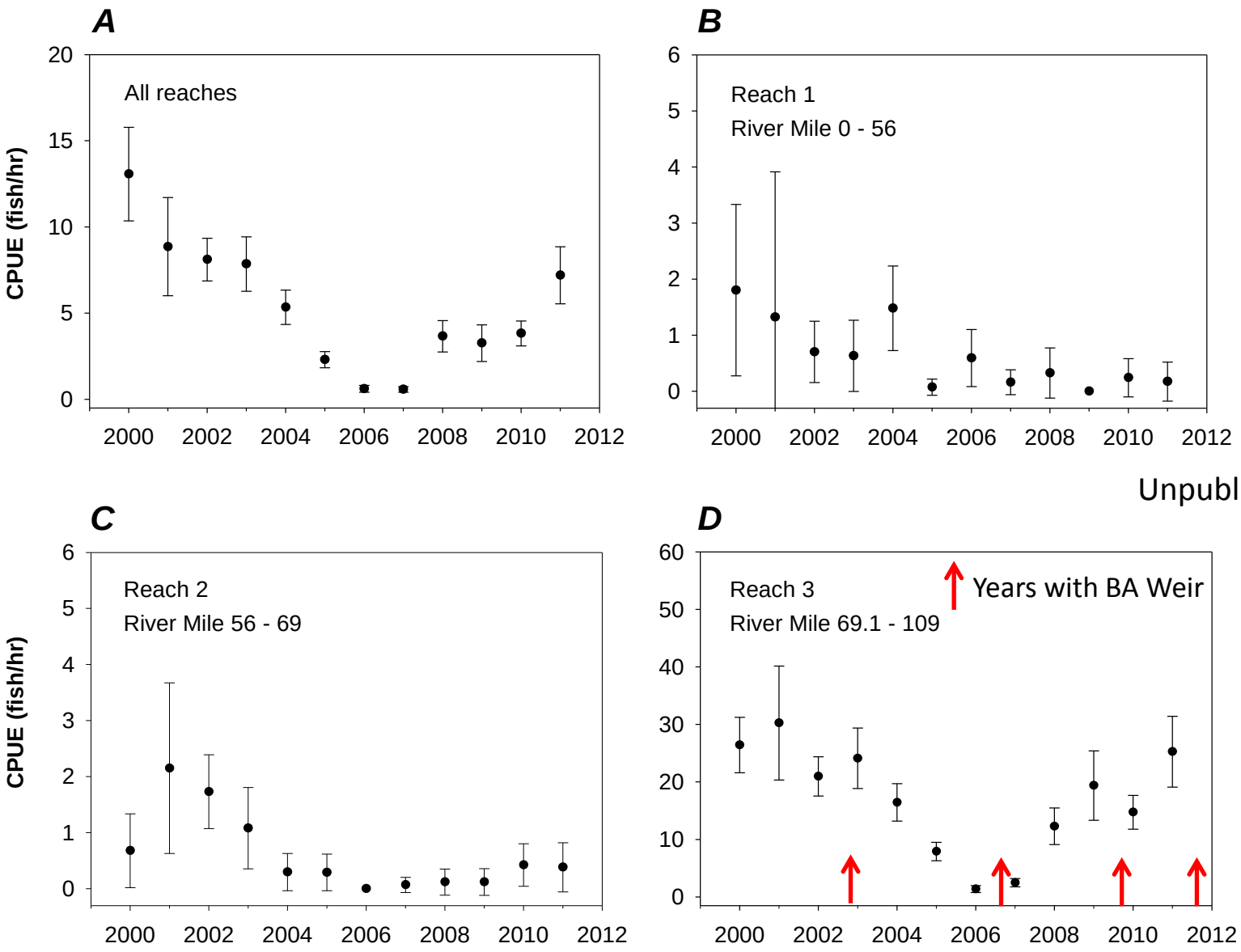


Unpublished AGFD data

Rainbow Trout CPE in NSE Reach Only



Trends in Brown Trout Catch Per Effort



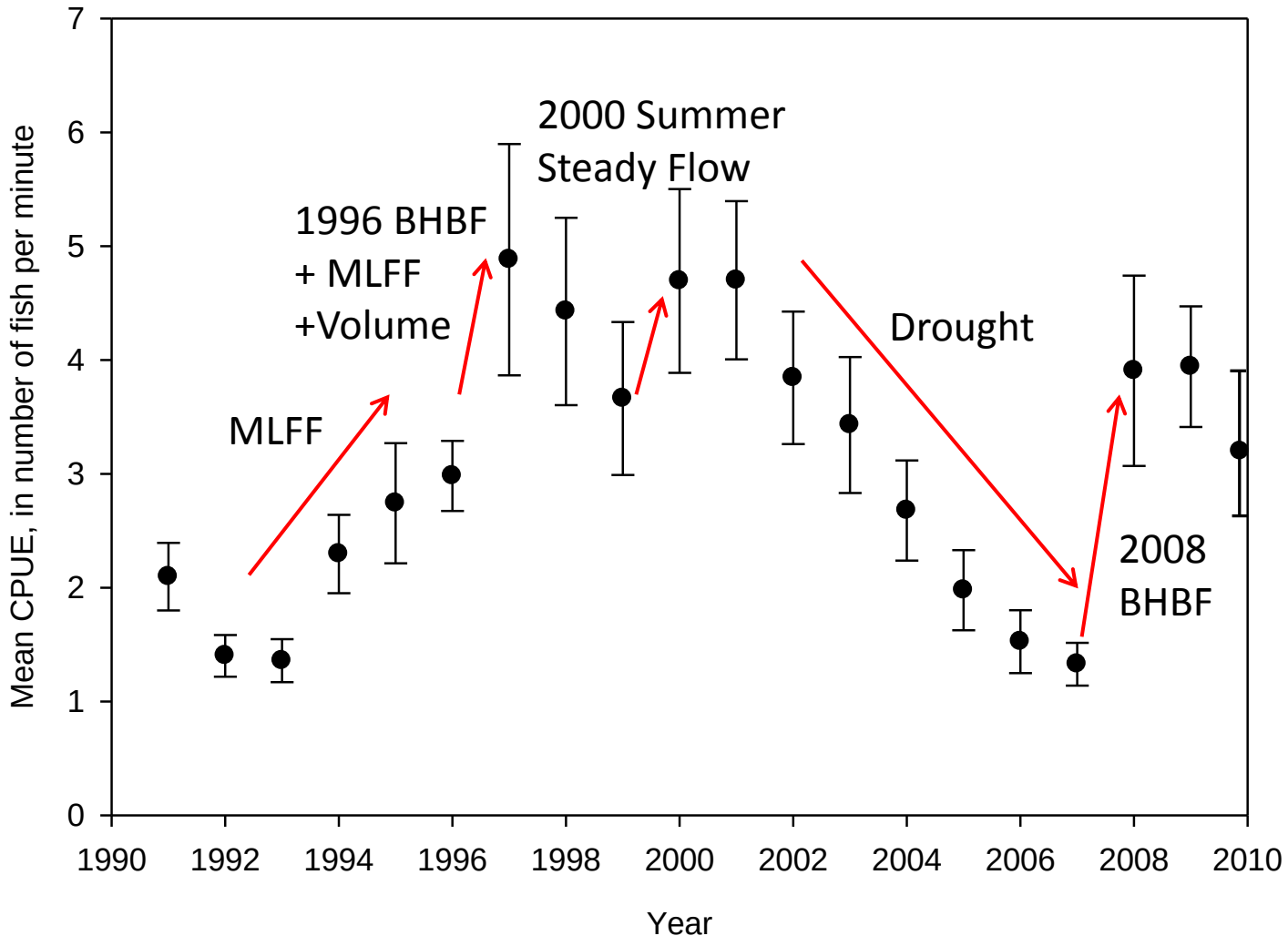
Unpublished AGFD data

Causes for Trends in Rainbow Trout Abundance

Part I:

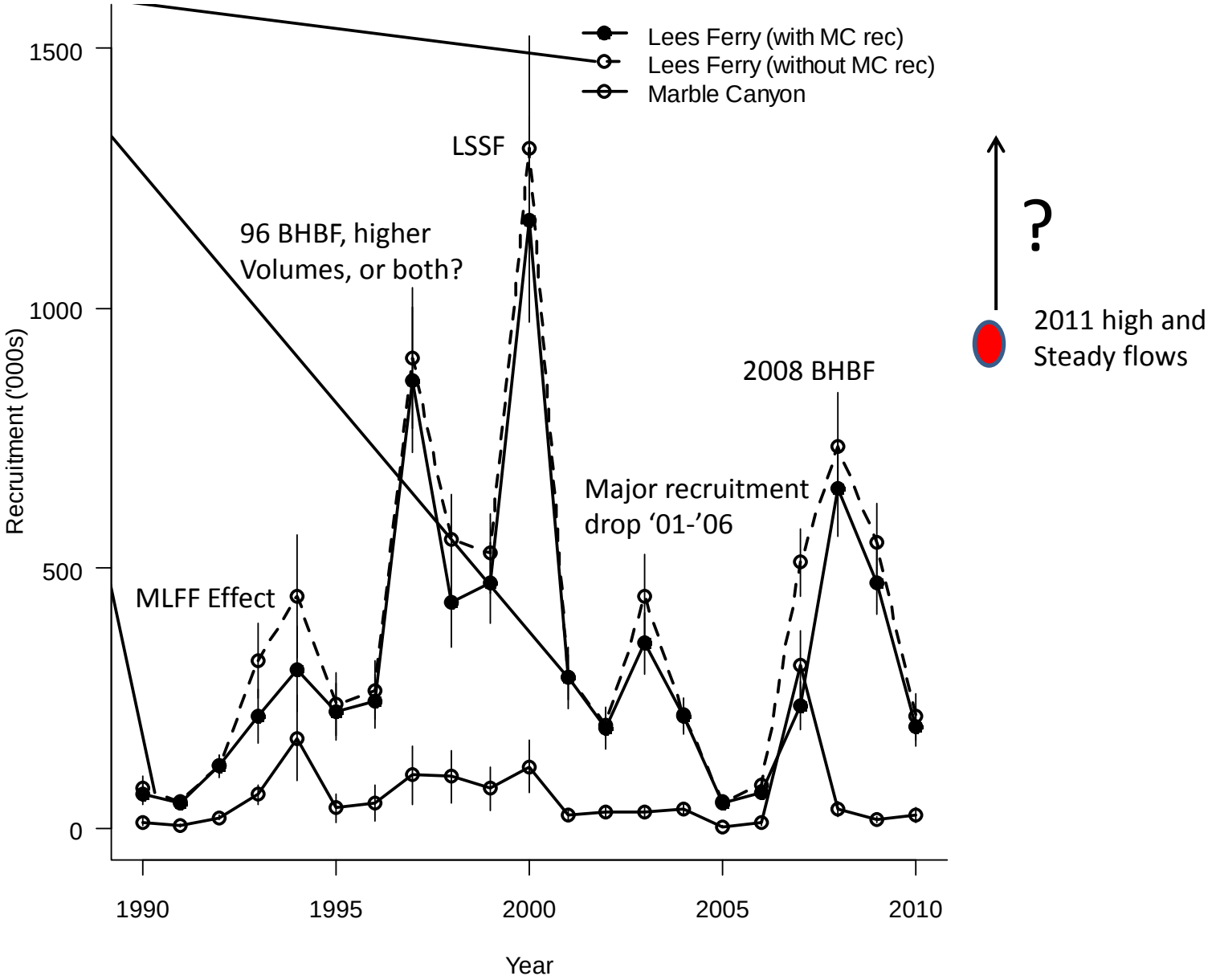
Evidence for Effects of GCD Operations on Recruitment to the Lees Ferry Population

Trends in Rainbow Trout CPE (mostly adults) in the Lees Ferry Reach and Hypotheses of Flow Effects



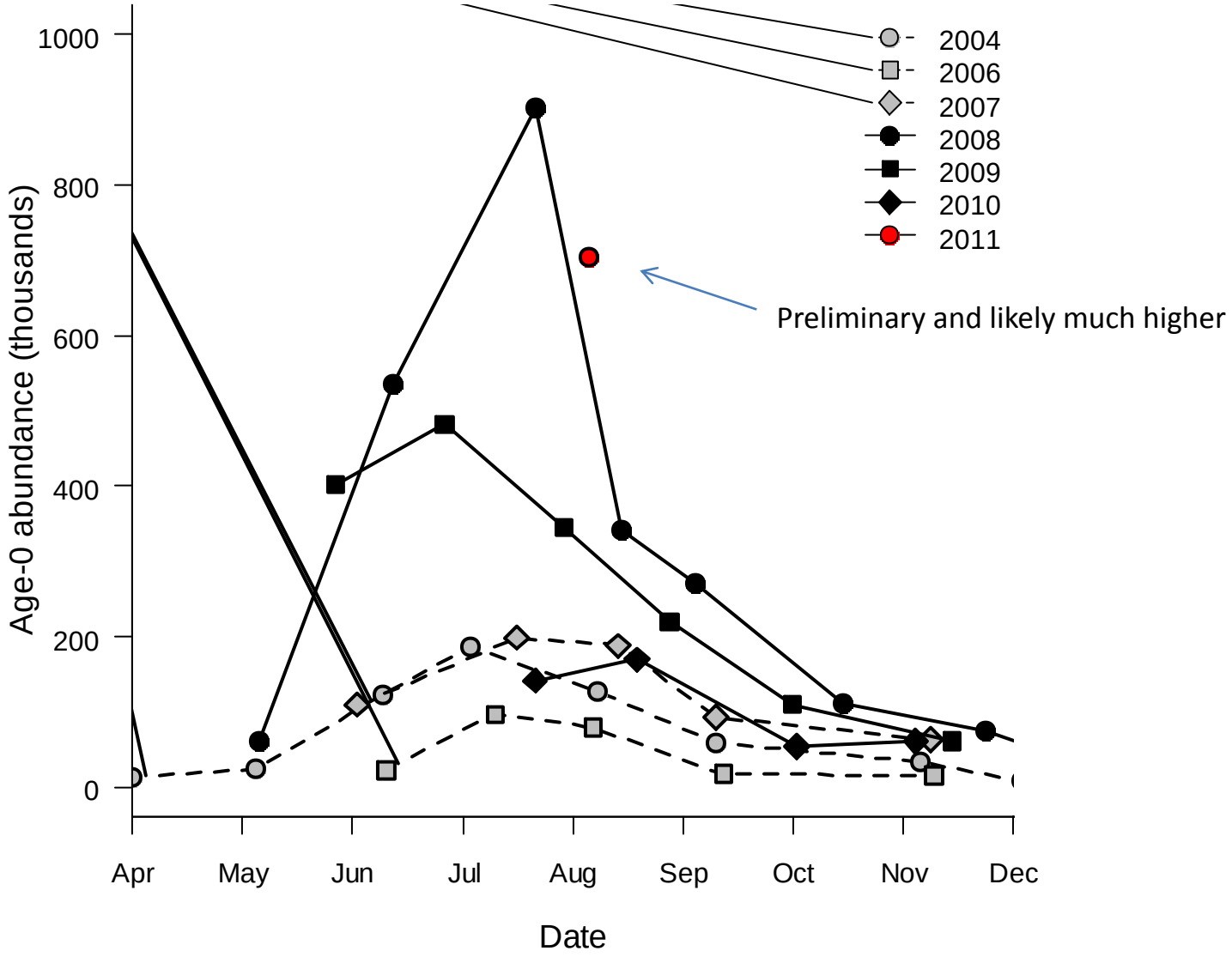
Source: Makinster et al. 2011

Modelled Recruitment Trend

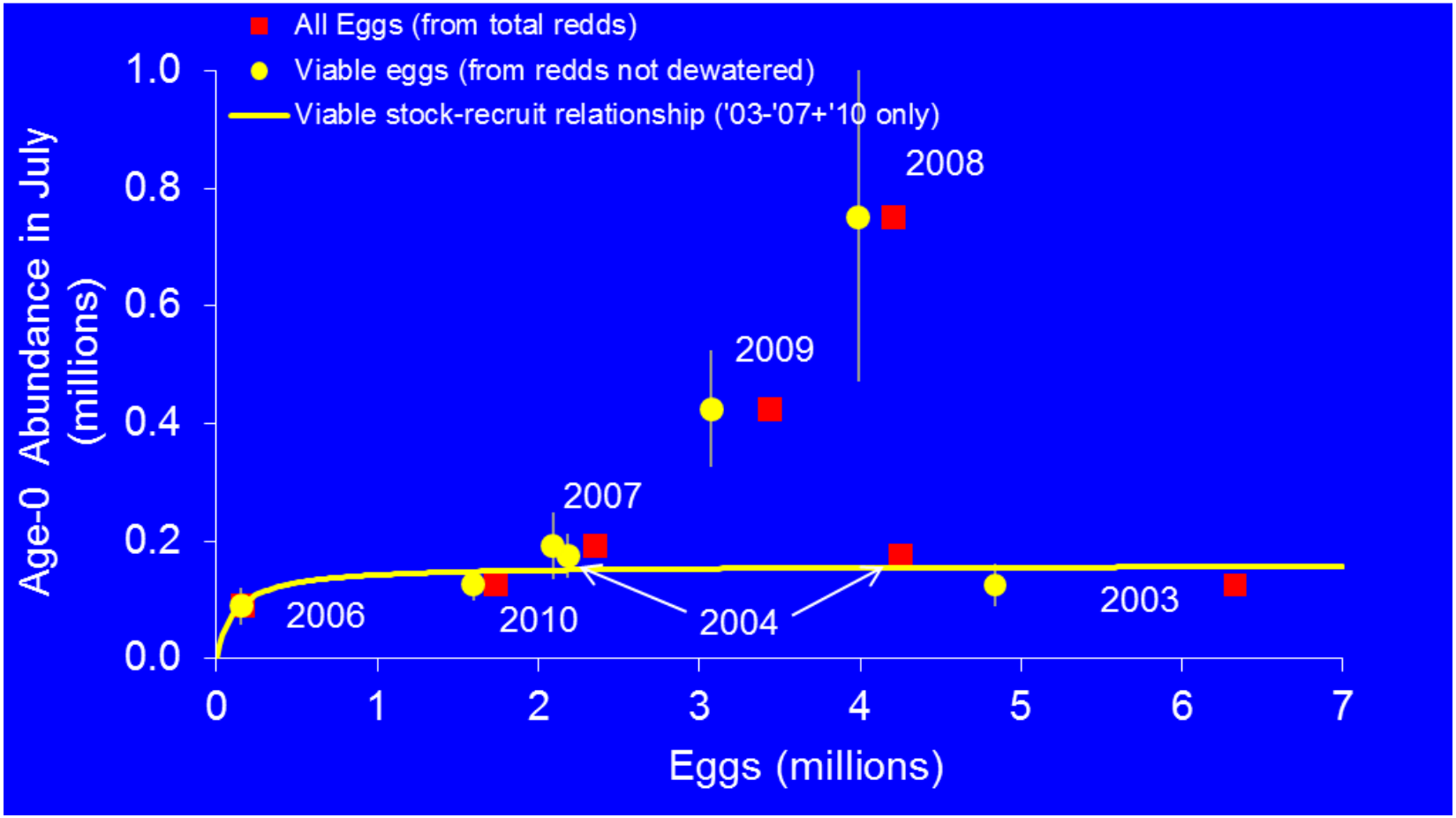


Source: Korman, Martell, Walters, Makinster, Coggins, Yard, Persons. 2011. In Prep

Direct Estimates of Rainbow Trout Recruitment in Lees Ferry (RTELSS)



Flow and Density Effects on Post-Emergent Survival Rates



+ hatch date analysis + food base data

Source: Korman, Kaplinski, and Melis. 2011

Conclusions on Rainbow Trout Trends

- Rainbow trout abundance in Lees Ferry and Marble Canyon has been increasing since ~ 2007.

- Some uncertainty in magnitude of increase in abundance at the LCR inflow reach (but it has gone up).
  - Limited sample size (# of sites)
  - Marble Canyon trend effected by spatial distribution of effort relative to the gradient in trout densities in MC (which varies by year)
  - Variation in turbidity among trips, limited # of trips in a year (1 or 2)
  - Catch standardized by time and not distance, and higher flows could be producing an upward bias (greater distance covered per unit time).

- Better estimate of RBT abundance in the LCR inflow reach needed if trout abundance is used as a trigger for removal activities, or to evaluate HBC response to trout abundance.

Conclusions Regarding GCD Effects on Rainbow Trout

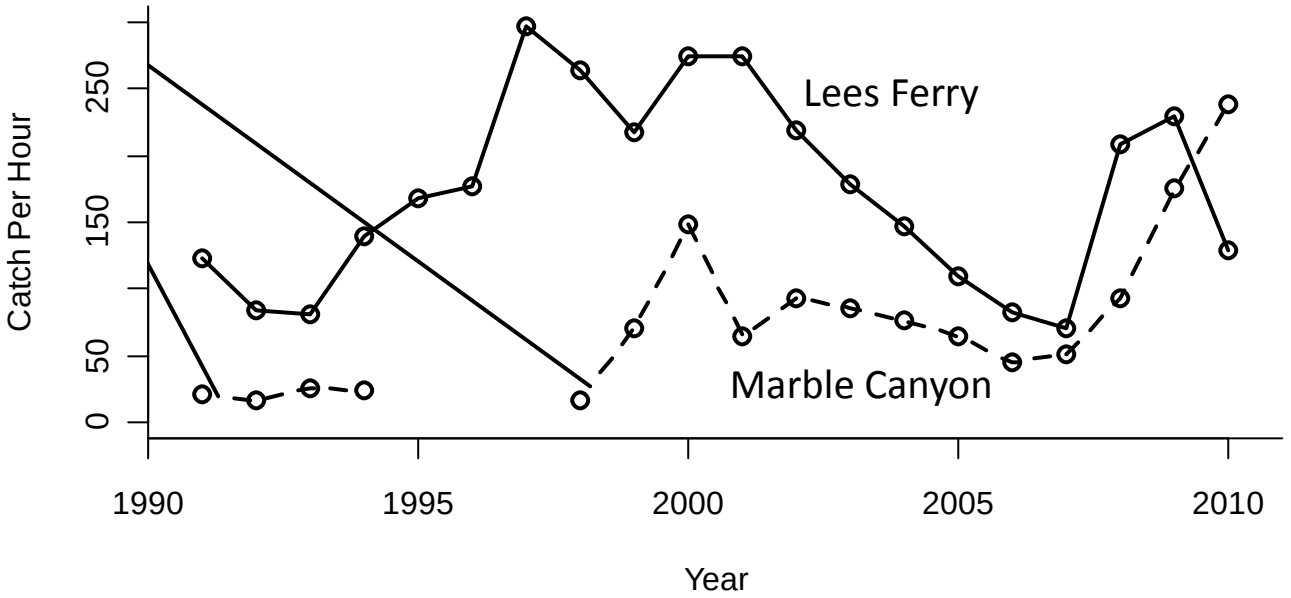
- Recruitment of rainbow trout in the Lees Ferry reach, as driven by survival rates of early life stages, is very sensitive to GCD operations. Why?
  - Monoculture (not complicated by interspecific competition and predation).
  - Reach is wide (sensitive to flow variation)
  - Juveniles are recruiting in mainstem, so early life stages are effected by dam operations.
- Response of rainbow trout to 2008 HFE and 2011 high and steady flows is relatively certain (and partially replicated based on '96/'97 response):
  - Response to future HFEs is <u>less certain</u> due to timing of floods and antecedent conditions (condition of bed, number of adult trout).
  - Other flow conditions (equalization) can produce lots of trout (high steady, low summer steady) so why single out HFEs?
  - If trout are a problem for natives, we need trout suppression regardless of whether HFEs are conducted.
- Response to Low Steady Summer Flows Uncertain
  - Magnitude of recruitment estimate in 2000 varies with uncertain assumptions.
  - Extent of outmigration may depend on flow regime after LSSF (high juvenile survival followed by reduced habitat for older stages after test).

Causes for Trends in Rainbow Trout Abundance

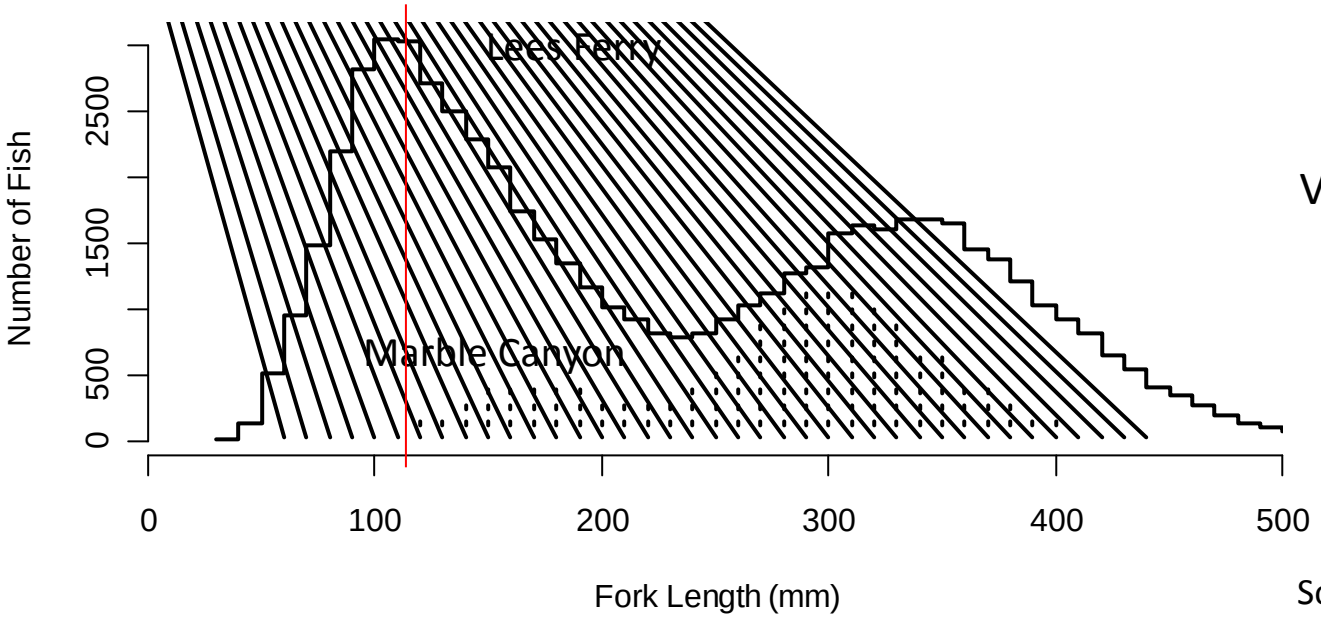
Part II:

Evidence for movement of trout from Lees Ferry to Marble Canyon

Raw Data Indicates a Likely Linkage Between Lees Ferry and Marble Canyon Populations



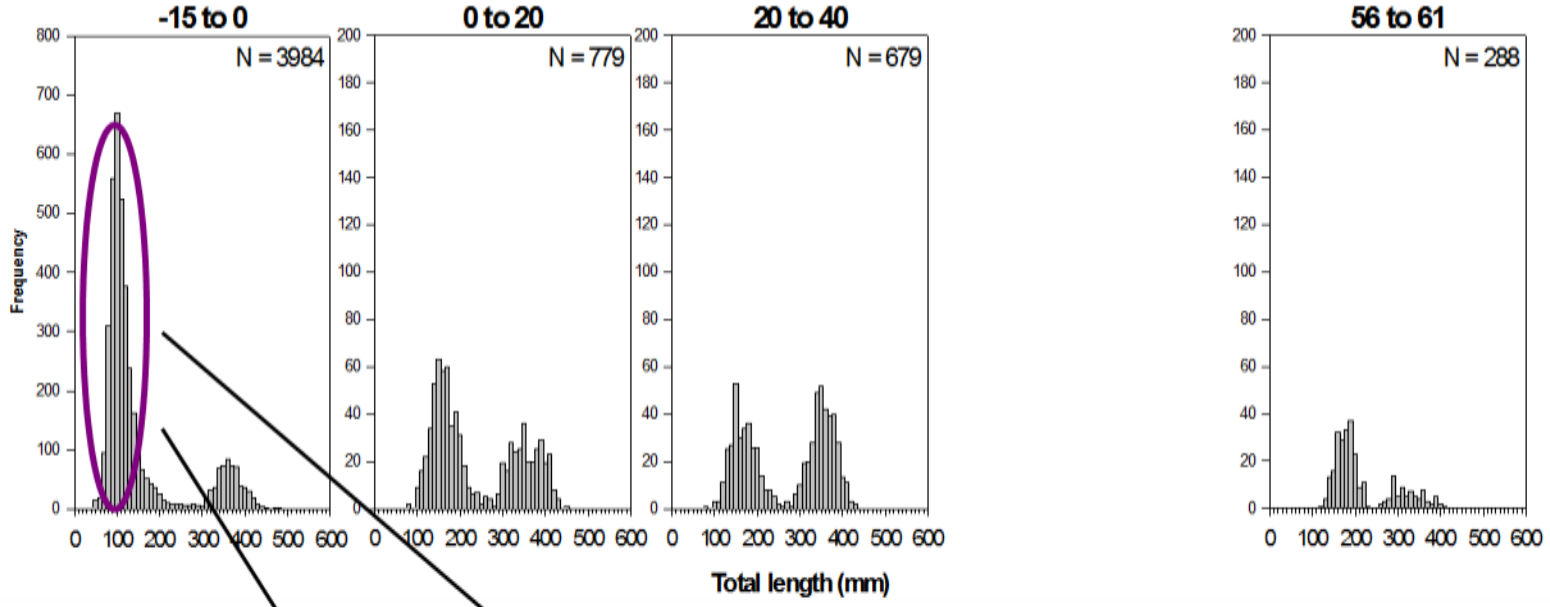
MC lags LF by a few years



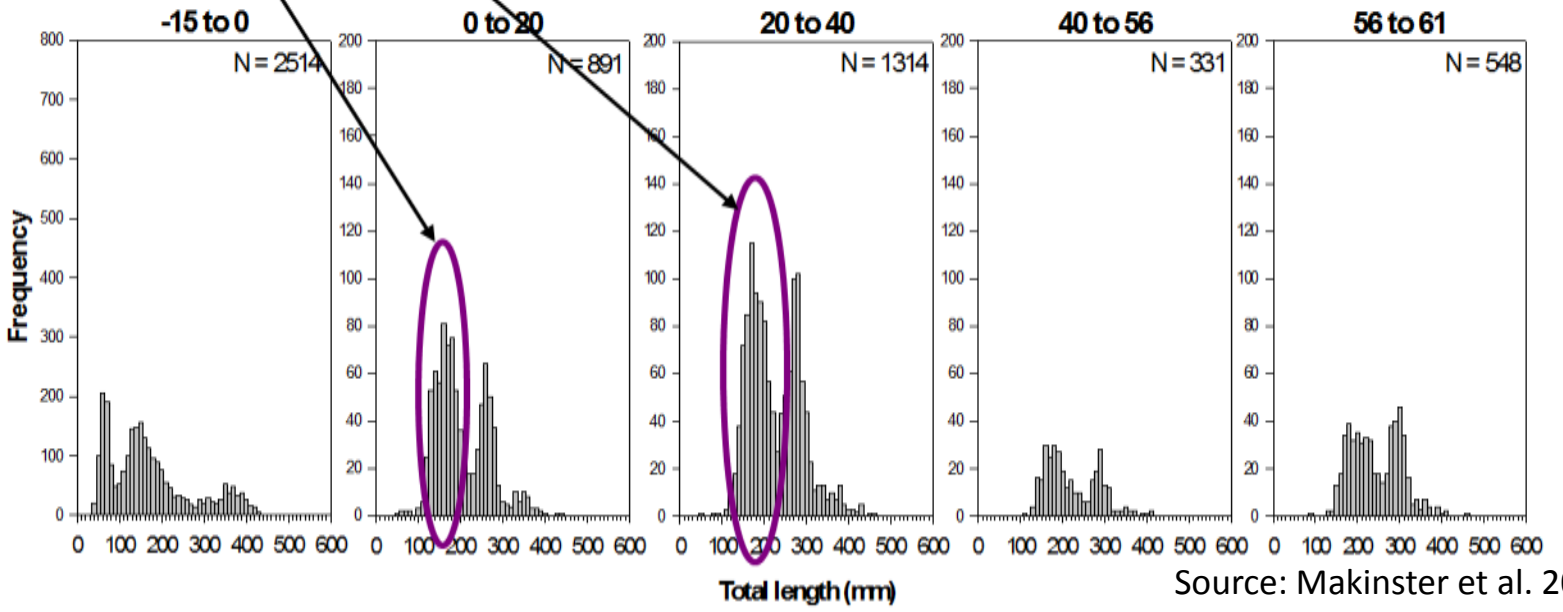
Very few age-0 trout in MC

Source: Makinster et al. 2010 data

Evidence for Outmigration from Lees Ferry



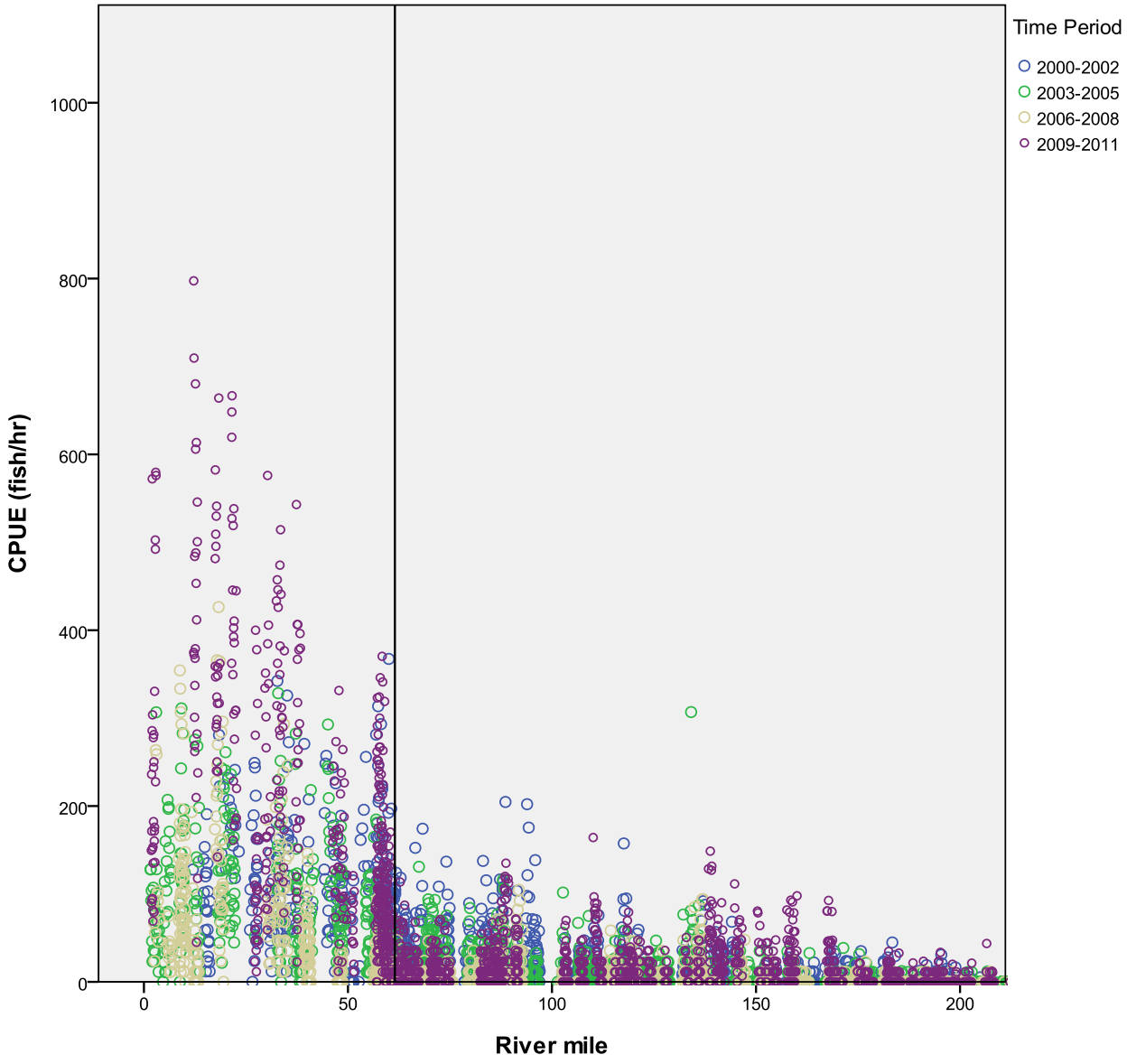
2008

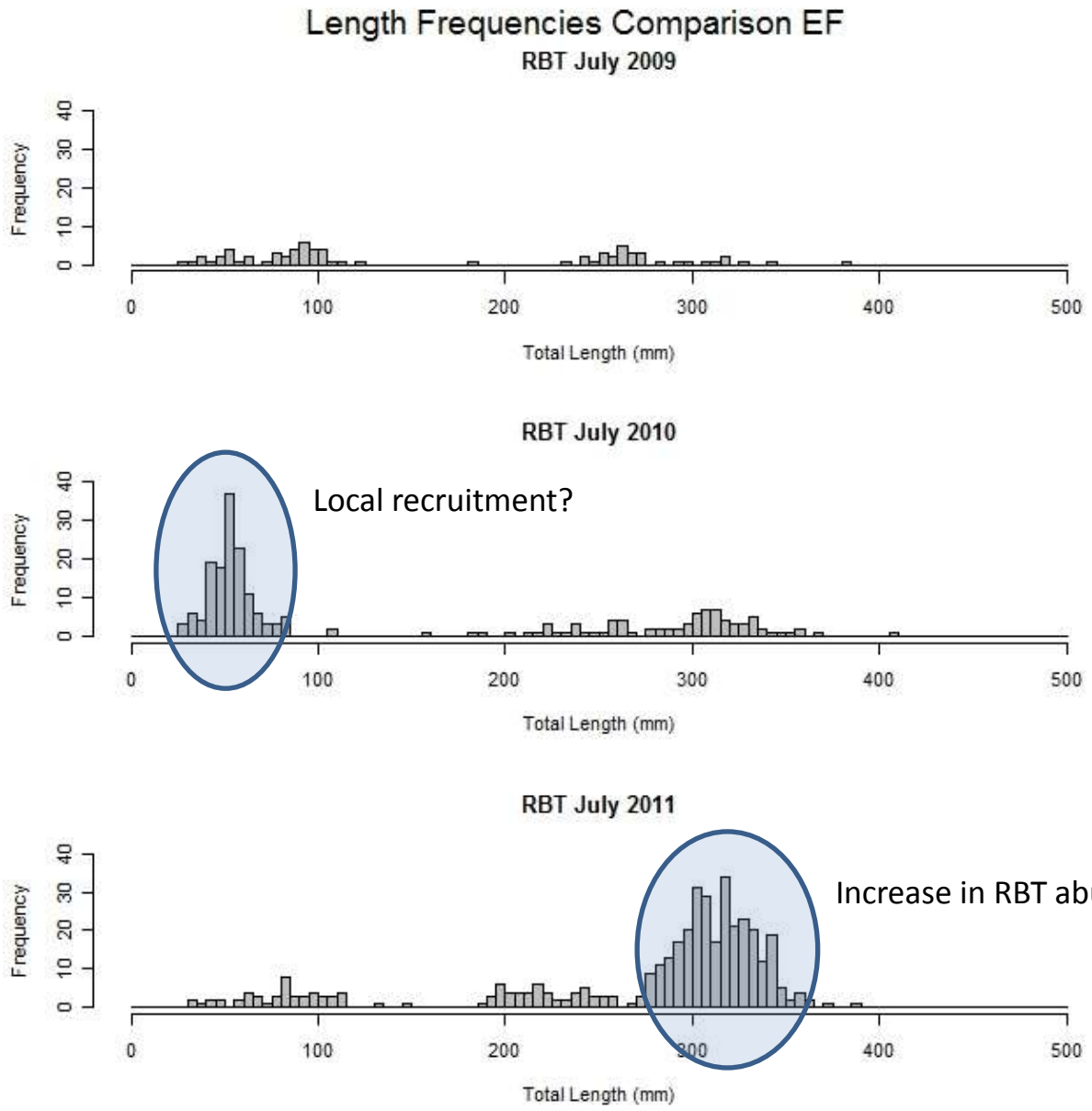


2009

Source: Makinster et al. 2010 data

Spatial Distribution of Rainbow Trout



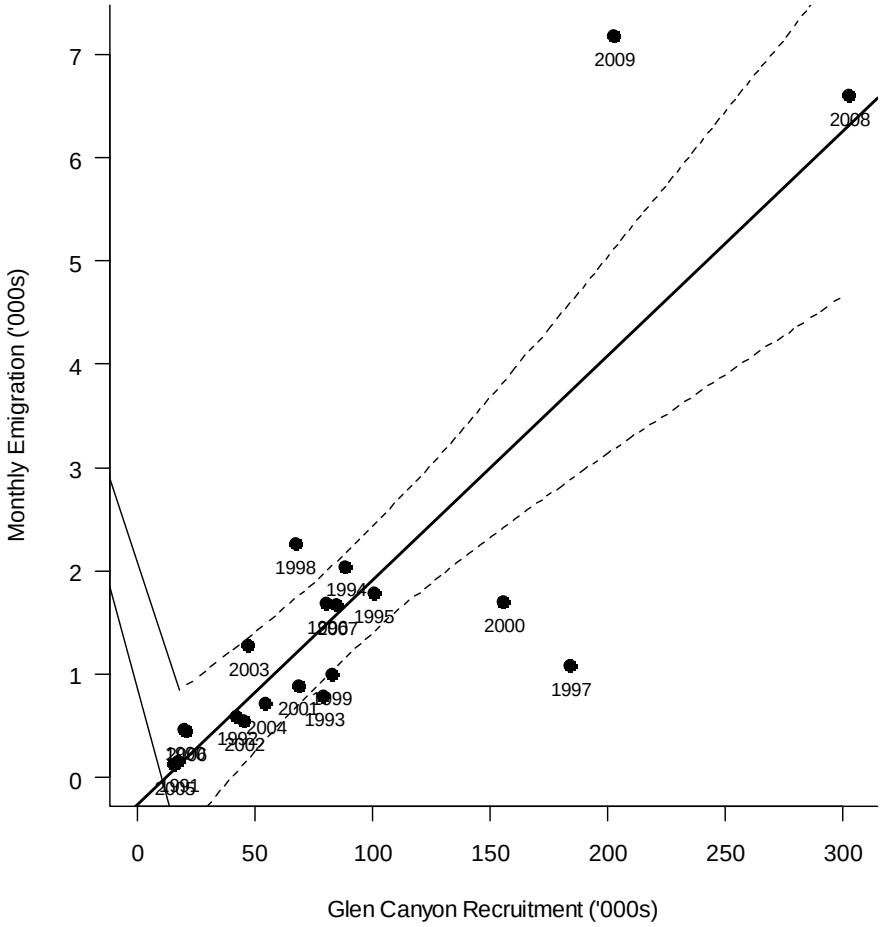


Evidence for Limited Local Recruitment in Marble Canyon or LCR Inflow Reach

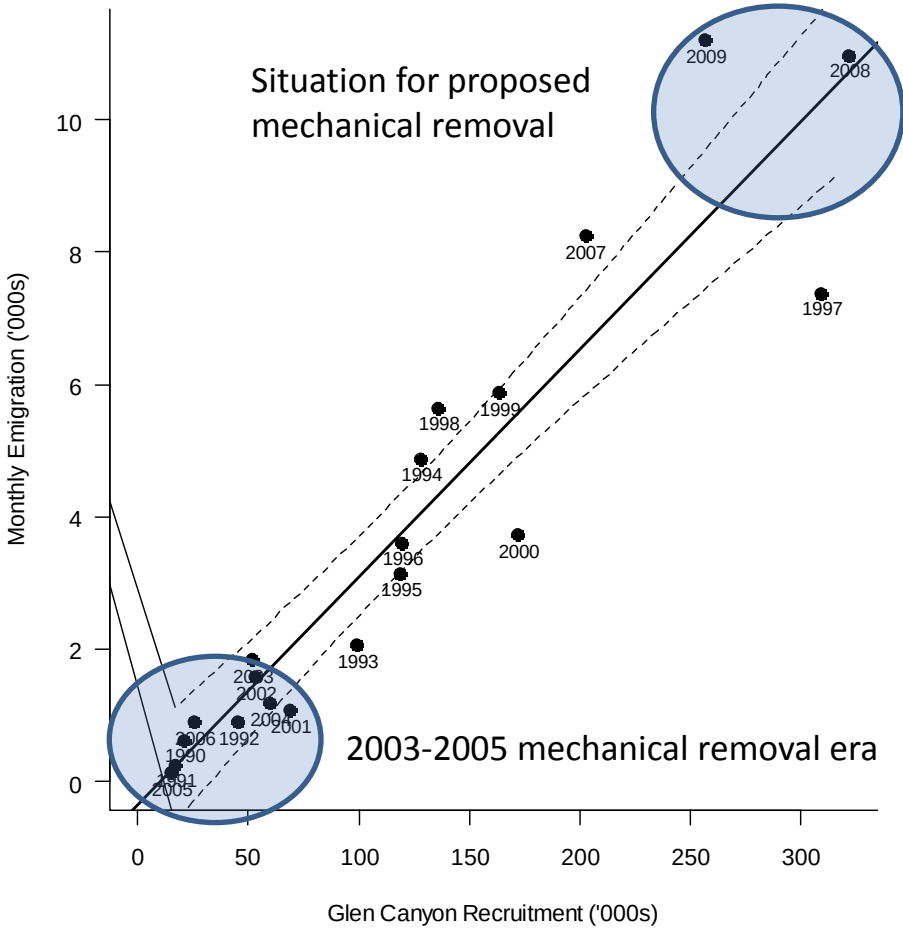
Pine, Dodrill, Finch, Gerig, Yard, unpublished data

Estimated Recruitment in Lees Ferry and Emigration to Marble Canyon Tightly Linked

With local MC recruitment



Without local MC recruitment



Source: Korman, Martell, Walters, Makinster, Coggins, Yard, Persons, 2011. In Prep

Conclusions Regarding Migration

- Data and model results indicate significant movement of trout from Lees Ferry to Marble Canyon.

- There is shaky evidence for local recruitment in Marble Canyon.
  - Age-0's in upper Marble Canyon in fall 2007 AGF trip (from Lees Ferry?).
  - Age-0's in upper Marble Canyon in fall 2011 from Natal Origins pilot (from Lees Ferry?).
  - Age-0's in NSE catch (likely local but probably trivial).

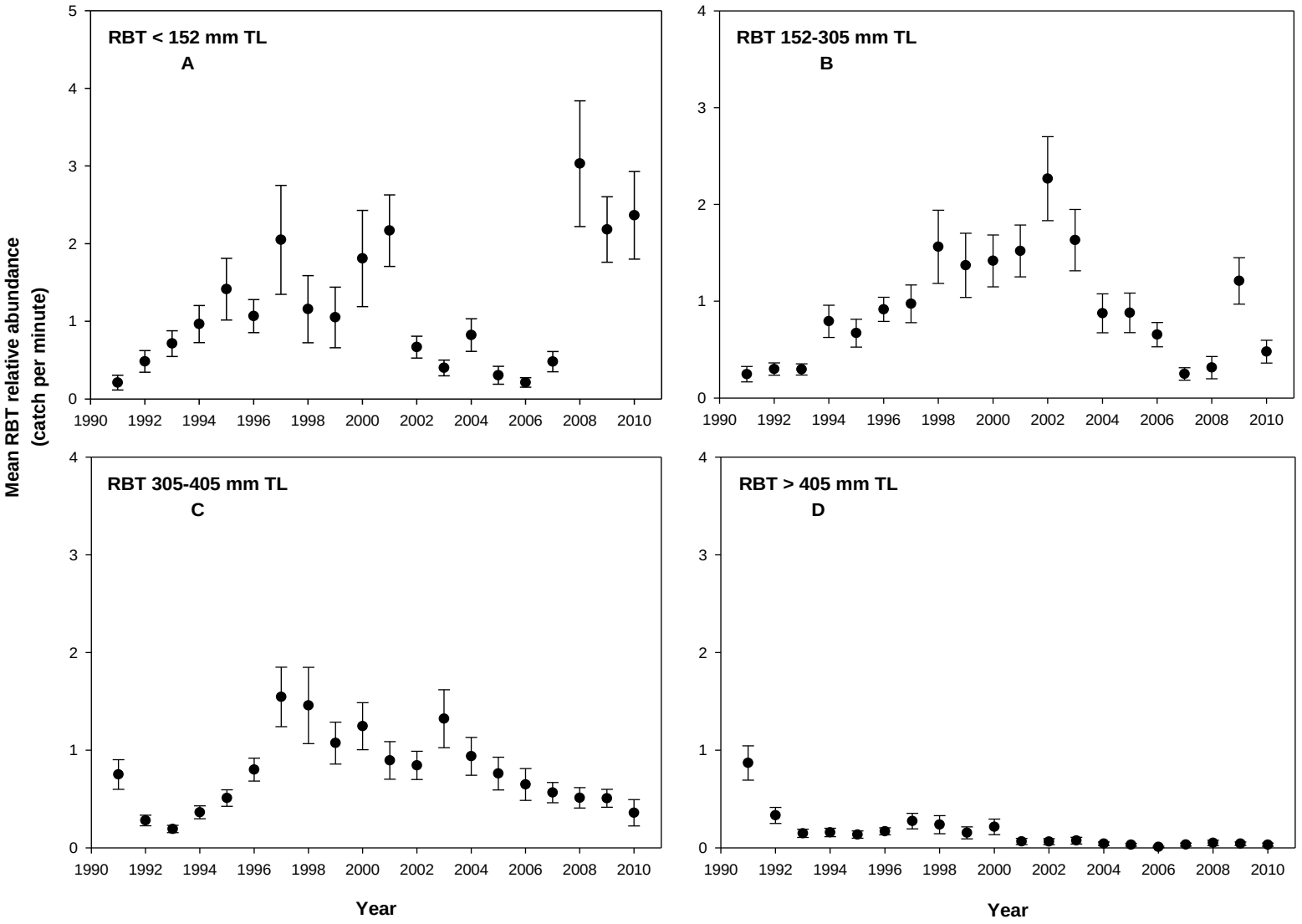
- Key uncertainties to be addressed by Natal Origins project:
  - What is annual # of trout that migrate from Lees Ferry, when do fish move (size, time of year), how long to they reside in the Paria-Badger reach?
  - How do conditions in Lees Ferry and Marble Canyon influence the amount of migration?
  - How significant is local recruitment to Marble Canyon population?
  - Latter 2 questions likely require more than 2 years of study.

Conclusions Regarding Trout Suppression

- Uncertain whether summer stranding flows will be effective at reducing rainbow trout abundance and outmigration
  - Easy to observe response.
  - Experiment not costly given high flows next summer.
- Uncertainties in mechanical removal in Paria-to-Badger reach
  - Importance of local recruitment near LCR inflow.
  - Residence time in PBR reach.
- Uncertainties in mechanical removal in the LCR inflow reach
  - Magnitude of immigration (backfilling).
  - Details in next talk (Yard)
- Uncertainties in efficacy of Bright Angel weir for brown trout suppression
  - No evidence of reduced abundance in mainstem associated with this removal activity.
  - Only removes a fraction of the mainstem population each year.
  - May not effect number of brown trout that migrate from BA to mainstem (need downstream trap or removal above BA weir).

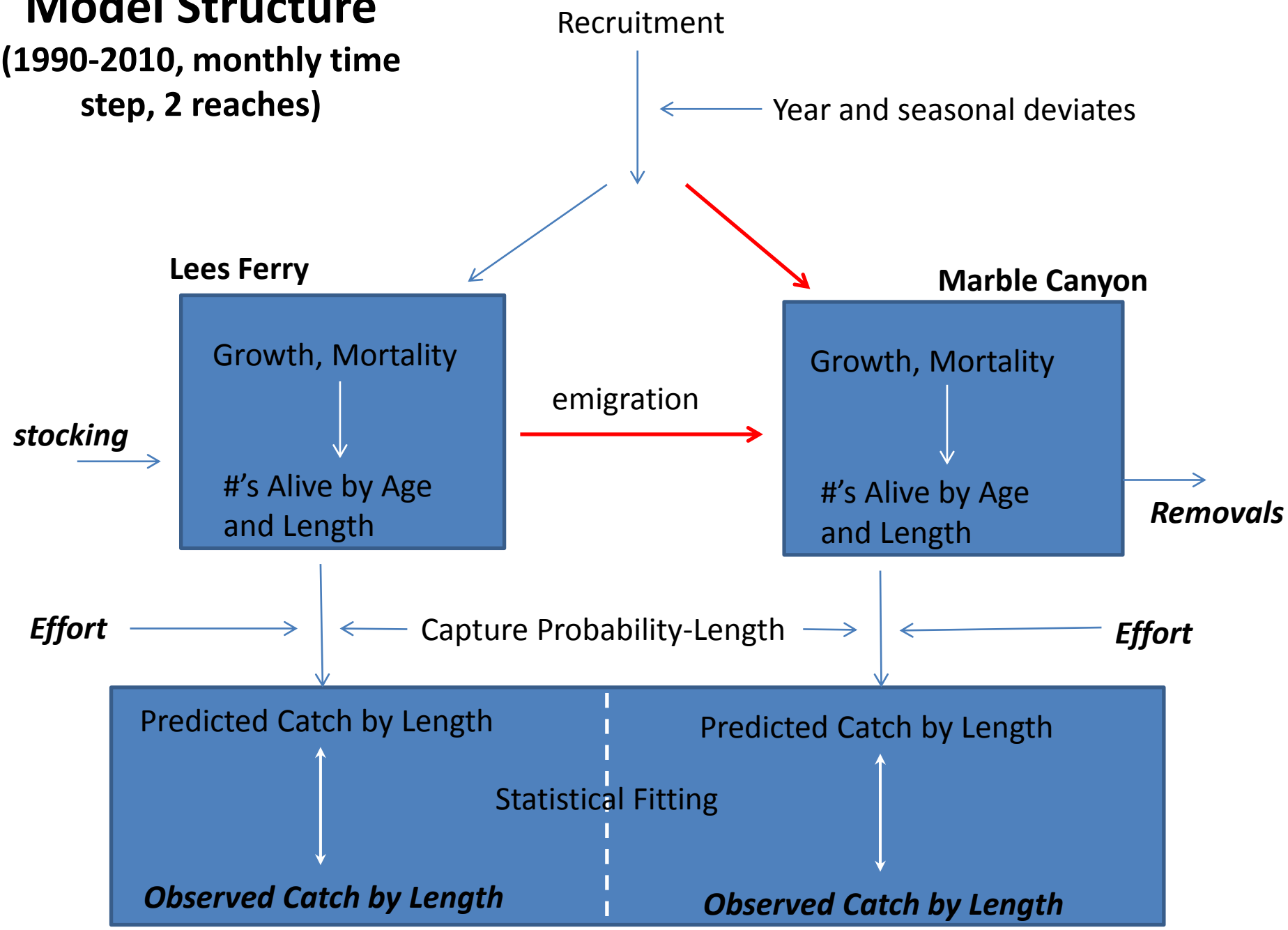
Extra Slides for Questions

Lees Ferry standardized electrofishing

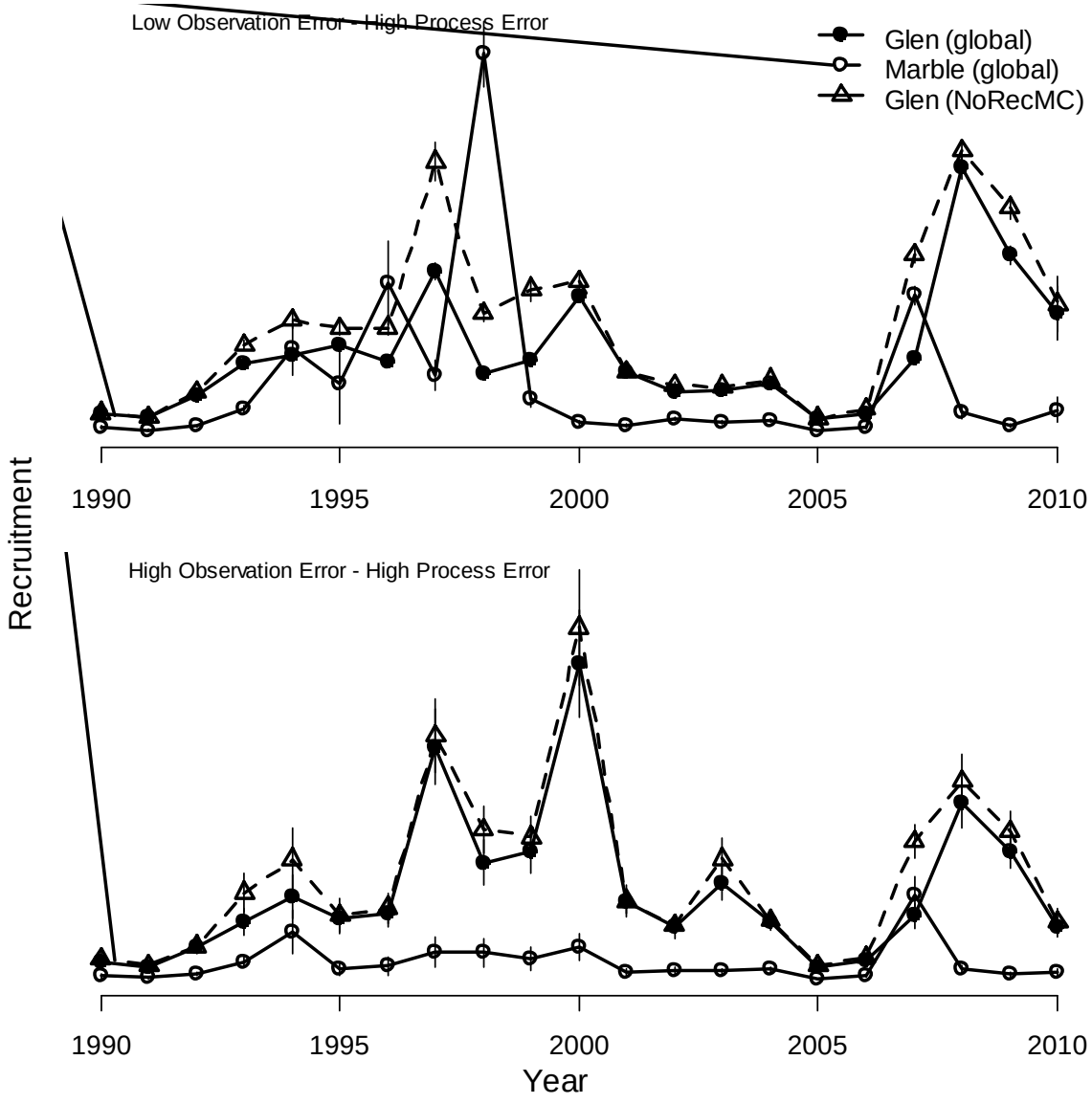


Model Structure

(1990-2010, monthly time step, 2 reaches)



Modelled Recruitment Trends in Lees Ferry and Marble Canyon With and Without Immigration



MC recruitment in '96, '98, '07

Little MC recruitment except in '07

Source: Korman, Martell, Walters, Makinster, Coggins, Yard, Persons, 2011. In Prep

Outmigration: Seasonal Timing and Fish Size